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| **Integrating biological control and precision horticulture toward the development of innovative cultivation methods to produce zero-residues fruit** |
| **Objectives:** Develop innovative cultivation methods based on precision agriculture to tailor human inputs including disease control methods to reduce chemical pesticides. Understand how to manipulate the cultivation environmental factors (light wavelength, intensity, frequency, CO2 level) to increase natural plant resistance to stress and maximize yield a fruit quality |
| **Expected Results:** i) Develop systems for early detection of pathogens disease and to tailor disease inputs on plant heath status or disease risk; ii) develop a protected cultivation systems under LED lighting to maximizes the use efficiency of energy water, fertiliser and disease control inputs and maximize yield and fruit sensorial and nutraceutical quality; iii) develop a system for automatic delivery of disease control inputs optimized for the greenhouse cultivation and for the novel control methods |
| **Task 1 Novel tools for monitoring plant physiological and health status:** Volatile organic compound (VOCs) are differently emitted by healthy, stressed and diseased plants. Effective and fast methods to sample VOCs from plants (e.g. electronic-nose, PTR-ToF-MS) will be developed for an early detection of diseased, but asymptomatic pants in real cultivation conditions. For a precise, early detection of pathogensa Loop-mediated isothermal amplification (LAMP) protocol will be developed. The lamp protocols will be validated in real cultivation conditions by the cooperation with growers and extension services.  **Task 2. Effect of LED light colour and greenhouse cultivation on disease, yield and fruit quality:** Cultivation in controlled conditions offers several advantages but greenhouse cultivation is not always energy efficient. The use of coloured LED lights substantially increases energy use efficiency, and may increase crop yield and quality, lowering, cultural inputs. Light composition/intensity also influence plant-pathogen interactions. Selected crop genotypes/varieties will be cultivated under different LED light regimes i) pulsed (250hz, 1khz, 30khz, 45khz, 60khz) or continuous light, ii) different spectral composition (e.g., UV-A, Blue, Red, Far-Red, White) and polychromatic combinations at different intensities. Their effect on i) plant resistance, ii) plant physiology (e.g. water use efficiency, photosynthesis), iii) productivity and fruit sensorial and nutraceutical quality will be assessed. Light effects on pathogen growth/virulence will be investigated at molecular and physiological level. This knowledge will allow to selected photoselective covers/nets to be used in open field cultivations.  **Task 3. Select alternative disease control measure.** Alternative to chemical pesticide will be screened with a specific focus on natural molecules and essential oils, nanoparticles and biological control agents. Furthermore, methods to increase their efficacy, such as microencapsulation and metabolic enhancement will be tested.  **Task 4. Innovative systems for automatic delivery of disease control inputs:** A precise and timely application of control inputs is essential to develop a sustainable disease control strategy, reducing spray volume and unnecessary treatments. Overcanopy automatic sprayers or mist systems will be adapted for irrigating strawberry plants in greenhouse. Different spray volume, drop size and frequency will be tested for the optimal coverage of the plants. The pipeline cleaning systems will also be optimised to prevent waste or washing of the applied products. Once optimised the novel application systems will be adapted for the application of the innovative control methods. |